ceramics, metals, carbon, glass compositions and organic polymers thermally bonded to the outer wall surface of said joined pipe lengths at a predetermined spatial angle with respect thereto for maximum effectiveness in withstanding applied internal stress when the reinforced pipe lengths are subsequently put into service, the continuous fibers having been continuously applied in an unbonded condition while maintaining the joined pipe lengths in their hollow condition and the subsequent thermal bonding of the applied fibers only adhering the applied fibers to the outer wall surface of the underlying pipe lengths without utilizing further adherence agents and while not further melting said underlying pipe length to avoid introducing thermally induced residual stress thereto.

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REMARKS

All remaining claims 1-3 and 5-9 in the now refiled CPA application have been still further amended to hopefully comply with the Examiner's requirement expressed in the Final Rejection of said claims in the previously filed CPA application. In said regard, the Examiner requires the present Applicant "to present evidence from which the Examiner could reasonably conclude that the claimed product differs in kind from those of the prior art". It is respectfully submitted that the now proposed as well as previously entered amendments made in the remaining claims clearly differentiates the claimed product from that either disclosed or obviously suggested in the sole Gibson et al reference being relied upon for reasons given below.

The previously entered amendments made in the remaining claims include recitation of a "hollow" thermoplastic pipe member or multiple pipe members being wrapped in a solid physical state with reinforcement fibers in "an unbonded condition" and which are thereafter thermally bonded to the "outer wall surface" of the underlying solid pipe member(s). In so doing, said pipe member(s) is required (as originally claimed) to be continuously moved "in the same linear direction" while the reinforcement fibers and continuously wrapped out the outer pipe surface. Understandably, such manner of forming the claimed product requires the moving pipe member(s) to be maintained in a solid condition during the fiber application which was also pointed out to the Examiner in an earlier filed amendment submitted by the

present applicant. While apparently not having sufficiently convinced the Examiner in said previous amendment that Gibson et al's method of forming such final products results in a structurally dissimilar article, it still remains evident that such structural dissimilarity exists in several critical other respects.

First of all, the requirement in Gibson et al to heat the underlying pipe to a "molten state" produces thermally induced residual stress in the final article which is a serious impediment far less encountered in the now claimed improvement. Gibson et al further requires a heating of the reinforcement fibers when applied which imparts still further thermally induced residual stress in the final article due to thermal expansions differences existing between said applied fibers and the underlying thermoplastic pipe as the final article cools. Such residual stress buildup in Gibson et al's final article detrimentally reduces the mechanical strength of the reinforced pipe member while not being readily discernible to visual inspection by any end user. Accordingly, cracks in the Gibson et al's final article can be more frequently encountered during subsequent use as can physical separation more readily occur between the "embedded" fibers and pipe member.

Secondly, the thermal expansion mismatch in the final Gibson et al article between the combined reinforcement fibers and the single thermoplastic pipe member being reinforced in said manner raises a still further problem. More particularly, it has long been recognized that reheating of a residually stressed thermoplastic member above its glass transition temperature can relieve such stress in the member. In doing so with Gibson et al's reinforced pipe member, however, the thermal expansion mismatch between the fiber and the underlying pipe becomes very likely to produce a physical separation therebetween during the reheating. Such destruction of the entire composite member is largely averted in the now claimed product by reason of a dissimilar method of fiber reinforcement being employed. In the present improvement, the entire outer surface of the pipe member(s) being reinforced is uniformly heated with external heating means surrounding said outer pipe surface. This manner of heating the outer surface produces a uniform stress distribution throughout the entire member with the fiber

reinforced final product exhibiting more dimensional stability as well as greater mechanical strength. As distinct therefrom, Gibson et al employs heating of the fibers when being applied which creates a localized stress condition in the composite article due to the above noted thermal expansion mismatch as the locally heated pipe area cools. In further requiring the entire underlying pipe member to be maintained in a "molten state" for proper fiber embedment, Gibson et al also risks far greater thermal degradation of said polymer material than experienced with the now claimed improvement. By selectively heating out the outer surface of said pipe member(s) in accordance with the now claimed improvement, the polymer material being heated is exposed to such degradation for a far lesser time period.

The now claimed product exhibits a still further structural improvement over the Gibson et al final article. Specifically, the present thermoplastic pipe member which remains solid when heated "only" on the outer surface (as recited in the now amended claims) to secure previously applied reinforcement fibers thereto undergoes a beneficial thermal expansion during said heating step. The thermally expanded pipe member presses against the already applied fibers thereby applying a compaction pressure causing the externally applied fiber to uniformly distribute the load across the pipe structure. Fibers that may have more load apply more pressure as they melt into the molten outer surface of the underlying pipe member and thus tend to equalize a load carrying capacity with more lightly loaded fibers that do not melt into the outer pipe surface as deeply. The end result is a more improved physical structure requiring less reinforcement fibers to provide the same mechanical strength than required in the Gibson et al final product.

The presently claimed product differs structurally in other critical respects from the final product disclosed or obviously suggested in Gibson et al. The thermoplastic member being fiber reinforced in Gibson et al is said to require a thermoplastic material selection which is both "melt-processable" and "shear sensitive" (see column 2, lines 9-10 in said reference) while further stating that a PEEK polymer would not be a suitable thermoplastic material (see column 2, lines 59-62 in said reference). The now claimed final product is not limited in the same regard and employs an already

prefabricated thermoplastic polymer for the underlying pipe member(s) which is particularly designed for this end-use application as well as not being available as a fiber material due to limitations in current fiber manufacturing procedures. Accordingly, the now claimed final product can employ prefabricated thermoplastic pipe members having mechanical fittings already adhered thereto, such as end fittings and the like, which Gibson et al's fabrication does not enable. Gibson et al's method of fabrication understandably further limits the length of a pipe members being reinforced. As distinct therefrom, continuous pipe lengths can now be reinforced as presently claimed. The underlying molten thermoplastic material in Gibson et al is also required to undergo "sufficient shear" action when the reinforcements are being applied (see column 2, lines 22-27 in said reference). Such required shearing action is caused with both external heating and external pressure being exerted upon the reinforcement fibers when applied. The underlying pipe member(s) remain solid when reinforcement fibers are applied in the present construction hence the now claimed final article is not subjected to any such required treatment. Having the final article fabricated in such dissimilar manner causes still other structural differences in the respective products. A use of commingled fibers in Gibson et al limits the applied fiber angle to approximately 15 degrees from the longitudinal axis of the underlying pipe member. Fiber angles in the now claimed reinforced pipe members(s) can include a 0 degree angle with respect to the longitudinal pipe axis. Likewise, the now claimed final article can employ reinforcement fiber devoid of any matrix polymer, such as strapping tape, which is not seen as obviously suggested for use in said reference.

Finally, still other dissimilar structural characteristics exist for the now claimed final article than are found in Gibson et al's final article. In the present improvement, the entire outer surface of the pipe member(s) can be uniformly heated by external heating means surrounding the outer pipe surface. This manner of heating the outer pipe surface produces a uniform stress distribution throughout the entire pipe member with the fiber reinforced final article exhibiting greater dimensional stability as well as greater mechanical strength. As distinct therefrom, Gibson et al

employs heating of the fibers when being applied which creates an undesirable localized stress condition in the reinforced article due to the above noted thermal expansion mismatch as the locally further heated region cools.

It can only be reasonably concluded from the above specified structural differences existing in the now claimed article from the final article either disclosed or obviously suggested in Gibson et al that sufficient factual evidence has been presented to rebut any prima facie question of obviousness found therebetween. It can only be unpermitted hindsight in view of the present applicant's teachings that can be regarded to obviously suggest the now claimed invention from a reference employing a dissimilar fabrication method employing entirely dissimilar means to produce a structurally dissimilar product. One skilled in the reinforcement of thermoplastic pipe members would not obviously consider from reading this reference that having the reinforcement merely bonded to the outer surface of an already prefabricated solid pipe member in a far more simplified manner could produce an unexpectedly superior final product. The limitation expressed in Gibson et al with respect to selection of starting materials as well as process conditions needed to produce the above demonstrated inferior product disclosed therein simply do not obviously suggest the now claimed invention. It is respectfully urged, therefore, that all now amended remaining claims 1-3 and 5-9 be allowed as structurally distinguishing over the structural features which neither exist in the Gibson et al final product nor is found obviously suggested in said reference.

An Appendix of the present claim amendments is also provided on a separate page accompanying this Amendment.

Respectfully submitted,

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CERTIFICATE OF MAILING

I HEREBY CERTIFY that this Amendment Before First Office Action is being deposited with the Postal Service in an envelope address to: Assistant Commissioner for Patents, Washington, D.C. 20231 on this 16th day of October 2002.

John F. McDevitt

APPENDIX

1. A fiber reinforced pipe length comprising a solid thermoplastic organic member having an outer wall enclosing an inner hollow cavity which includes a plurality of continuous juxtapositioned reinforcement fibers formed with a solid material composition selected from the group consisting of ceramics, metals, carbon, glass compositions and organic polymers thermally bonded to the outer wall surface at a predetermined spatial angle with respect thereto for maximum effectiveness in withstanding the applied internal stress when the reinforced pipe length is subsequently put into service, the continuous fibers have been continuously applied in an unbonded condition while maintaining said pipe length in its hollow condition and the subsequent thermal bonding of the applied fibers [primarily] only adhering the applied fibers to the outer wall surface of the underlying pipe length without utilizing further adherence agents[.] and while not further melting said underlying pipe length to avoid introducing thermally induced residual stress therein.

7. A plurality of identical fiber[s] reinforced pipe lengths joined together prior to reinforcement at the ends and each comprising a solid thermoplastic organic polymer member having an outer wall enclosing an inner hollow cavity, said joined pipe lengths having a plurality of continuous juxtapositioned reinforcement fibers formed with a solid material composition selected from the group consisting of ceramics, metals, carbon, glass compositions and organic polymers thermally bonded to the outer wall surface of said joined pipe lengths at a predetermined spatial angle with respect thereto for maximum effectiveness in withstanding applied internal stress when the reinforced pipe lengths are subsequently put into service, the continuous fibers having been continuously applied in an unbonded condition while maintaining the joined pipe lengths in their hollow condition and the subsequent thermal bonding of the applied fibers [primarily] only adhering the applied fibers to the outer wall surface of the underlying pipe lengths without utilizing further adherence agents [.] and while not further melting said underlying pipe length to avoid introducing thermally induced residual stress therein.